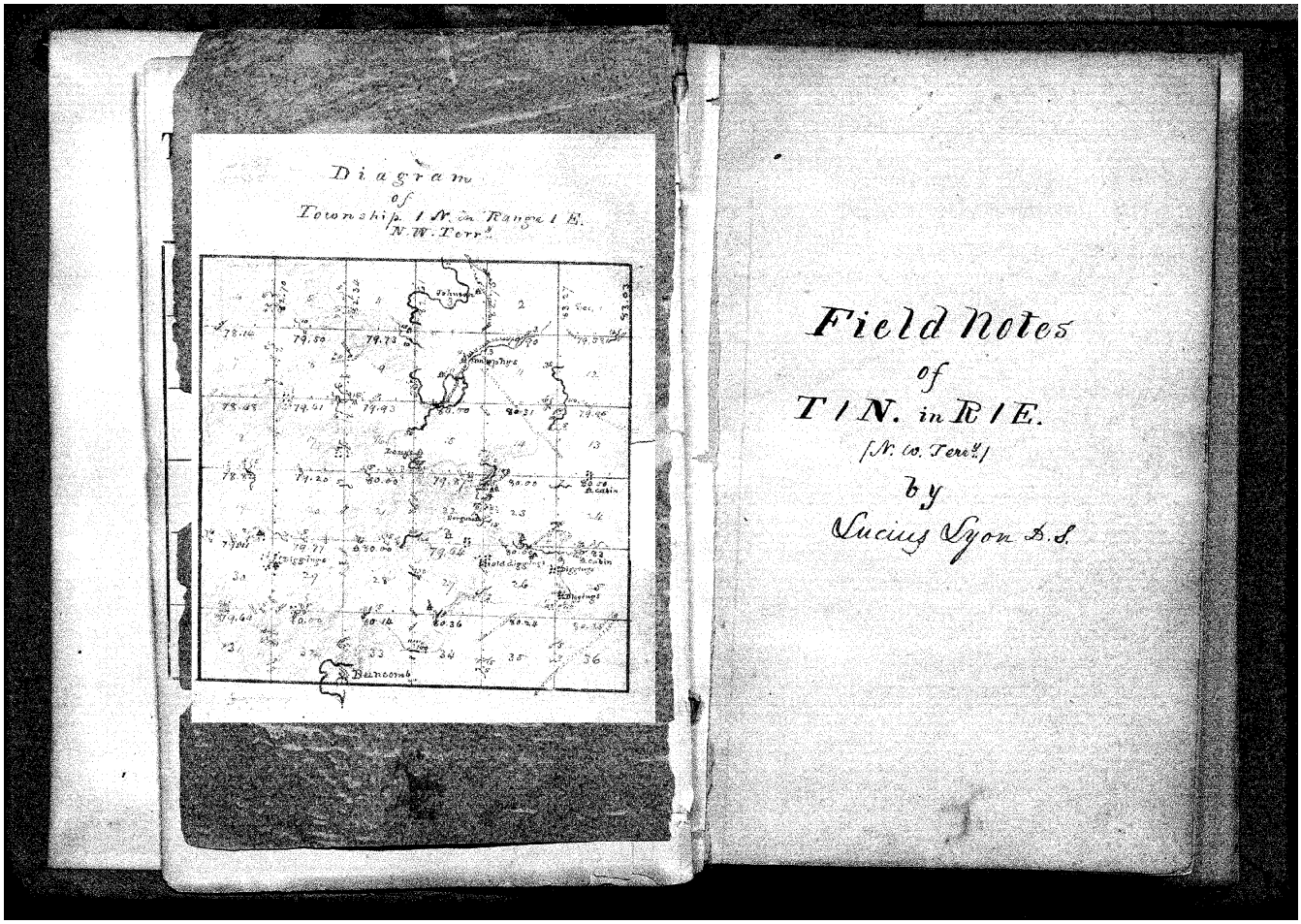

Pre-European Settlement Vegetation of Wisconsin

Database Documentation

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Forest Landscape Ecology Lab
University of Wisconsin – Madison

This documentation was compiled by:

Ted Sickley
Forest Landscape Ecology Lab
Department of Forest Ecology and Management
University of Wisconsin-Madison
120 Russell Labs; 1630 Linden Drive
Madison, WI 53706

tsickley@facstaff.wisc.edu
(608) 265-6321

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Principal investigator:	David J. Mladenoff Department of Forest Ecology and Management University of Wisconsin-Madison	
Coordinators:	Kristen L. Manies Theodore A. Sickley	
Data entry, quality control, patience, and sense of humor:	Shaun Anderson Julie Block Jon Boerner Carrie Cash Susan Crowley Jennifer Dahms Benjamin Ford Nicholas Guries Andrea Hildebrandt Jason Jones Thomas Katz Daniel Kloiber Rebecca Kurziak Wendy Lai Liang Li	Rhonda Mathison Sheryl Moor Etsuko Nonaka Timothy Parshall Heidi Platt Jesse Ray Stefania Rok Erik Schuck Nathan Schuck Anna Scofield Amy Sloane Charles Staeven Theran Stautz Jedd Ungrodt Hansheng Wang

Executive Summary

Between 1832 and 1866, contractors to the United States government surveyed the largely unsettled lands of what today constitute the State of Wisconsin for the purpose of subdividing and selling land to settlers moving west from the eastern states and from Europe. The survey was carried out in a systematic manner, with survey posts set every half mile along a grid of one mile square blocks of land called sections. Although this was a land survey rather than a botanical survey or inventory, the field notes recorded by the surveyors contain abundant vegetative information that represent to most complete picture we have today of how the landscape and flora of Wisconsin appeared before widespread European-American settlement and the accompanying clearing, logging, and agricultural activities.

We reviewed the entire set of field notes for the state of Wisconsin and compiled tabular databases of biological and ecological information contained in the notes. The following documentation provides a brief historical overview and description of the US public lands survey system (PLSS), its application to Wisconsin, an outline of our databases and their contents, and perhaps most importantly, a review of caveats and limitations to the use of the data. The databases we have compiled will be of enormous use to ecologists, foresters, planners, and land managers who are interested in the pre-European landscapes of Wisconsin and the subsequent changes to the land, but they must be approached with care and a full understanding of the inherent biases contained within the survey that will affect how the data are used.

Cumulatively, the databases contain over 300,000 records with information about 180,000 survey points, 450,000 individual trees, and 23,000 ecological boundaries between ecosystems, all of which can be explored and analyzed using conventional statistical methods. In addition, the Wisconsin Department of Natural Resources has produced a geographic information system (GIS) database of statewide PLSS corners, to which we are able to attach our tabular data. This then allows for the mapping and spatial analysis of the information.

General background and description

In 1785 the Continental Congress of the United States enacted the Land Ordinance which described a procedure for subdividing and disposing of the country's unsettled western territories. The federal government wanted to populate these territories and was already carrying a substantial debt from the Revolutionary War that it wished to retire with capital raised through the sale of land. The Surveyor General of the United States was appointed to supervise this survey and report to the Secretary of the Treasury. To further facilitate the survey, Congress established the General Land Office (GLO) within the Department of the Treasury in 1812. A method of rectangular land subdivision known as the public land survey system (PLSS) was developed in eastern Ohio in the late 1700s and applied westward across the country. The lands that are now within the State of Wisconsin were surveyed between 1832 and 1866, with 5 townships in Indian reservations completed in 1872, 1873, and 1891. Initially this area was part of the Northwest Territories, then part of the Michigan Territory, then the Wisconsin Territory, and ultimately in 1848 the State of Wisconsin. Surveys of the territories that comprise the remainder of what is today known as the lower 48 states were completed by the early 1900s.

Under the public land survey system, the subdivision of a given area began with the establishment of two surveyed lines: an east-west trending baseline and a north-south trending principal meridian. Land was first divided by surveying east-west township lines parallel to the baseline and north-south range lines parallel to the principal meridian at six mile intervals. This resulted in a grid of square areas called townships, each six miles on a side. Townships were subsequently subdivided into 36 sections, each 1 mile square. The location of a given township is identified as so many townships north or south of the baseline and so many ranges east or west of the principal meridian. The baseline for Wisconsin was established with the survey of the northern boundary of the Illinois territory in 1832. The 4th Principal Meridian, which had been used in the survey of Illinois, was extended north from the baseline to Lake Superior (Figure 1).

A district Land Office, overseen by the district Surveyor General, was established in each region that was to be surveyed. The work was conducted by Deputy Surveyors, who contracted with the district Surveyor General to survey township lines or interior section lines for blocks of

townships at a time. The Deputy Surveyor received instructions with the contract detailing the manner in which the survey was to be conducted. He was paid by the mile of survey, and with this money he hired a crew to assist him, purchased necessary supplies, and paid himself. In Wisconsin, the crew generally consisted of two chainmen who carried the chain used to measure distances, one or two axemen who constructed wooden survey posts and blazed and marked trees, and a flagman.

Distances along the survey lines were reported in chains and links. One chain equaled 66 feet (4 rods) and was comprised of 100 links. There were 80 chains or 8000 links to the mile. Survey posts were set along township and section lines every mile at locations designated as section corners. Additional survey posts were set at the midpoints between section corners at locations called quarter section corners (Figure 1). The presence of quarter section corners allowed for the future protraction of sections into quarter sections if desired. At each section and quarter section corner, a survey post was constructed of wood from the forest and set into the ground, and between 2 and 4 trees were identified as witness or bearing trees. The location of the corner, the type and diameter of each bearing tree as well as its compass bearing, or azimuth, and distance from the corner were recorded in the survey notebook. In areas without trees such as prairie and marshes, mounds of earth or stone were constructed to mark the location of the corners.

Where a section line intersected a navigable lake or river, the surveyor set a meander corner on the shore at the point of intersection, surveyed around the water body to the opposite shore along the same section line, set another meander corner, and continued surveying. Meander corners were also established when survey lines intersected boundaries of Indian reservations or preexisting private land claims, although the surveys did not generally extend into these areas. Meander corners resembled section corners: survey posts were set into the ground and bearing tree information (species, diameter, azimuth, and distance) was recorded in the notebooks.

The surveyor and his crew recorded other features that they encountered as they walked the section lines. The type and diameter of trees occurring along or very near sections lines,

called line or station trees, were noted, as were significant natural and cultural features such as swamps, marshes, ridges, ravines, meadows, thickets, prairies, lakes, ponds, rivers, river bottoms, streams, springs, windfalls, burned areas, homesteads, fields, villages, roads, trails, and many others. Figure 2 shows the field surveyors notes for several section lines in Township 35 North, Range 16 West.

At the end of every mile of survey completed, the surveyor recorded the nature of the land surface (e.g., level, rolling, broken) and soil (first, second, or third rate) as well as the dominant timber and understory species seen along that mile. The field notes for many townships are followed by a general description of the township regarding its current physical characteristics, the presence of settlement or improvements, and its economic potential for agriculture or timber production (Figure 3).

All field notes for the townships covered under a given contract were deposited with the Surveyor General at the district land office upon fulfillment of the contract. For Wisconsin, these offices were first in Cincinnati, Ohio, and later in Dubuque, Iowa. Government scribes and draftsmen in the district offices recompiled the notes into notebooks arranged in columns of townships and drafted accurate plat maps of each township at a scale of 1:63,360 (1 inch = 1 mile). Plat maps show the lengths of all township and section lines, the areas of each section and quarter section available for sale (with the area covered by meanderable bodies of water subtracted), water bodies, and some of the natural and cultural features mentioned in the notes (Figure 4). Wisconsin's field notes were compiled into 311 notebooks covering the subdivision of land into townships (called exterior surveys), and 360 notebooks covering the subdivision of townships into sections (interior surveys). The state Board of Commissioners of Public Lands maintains the notebooks and plat maps, which have been microfilmed and scanned into digital files.

More information regarding the General Land Office survey in the United States can be found in Stewart (1935) and White (1983).

General database description

We systematically went through microfilms of all the surveyors' notebooks for Wisconsin, extracted vegetation information, and entered it into a tabular database. Entries from the notebooks were assigned to one of five data types: section and quarter section corners, meander corners, line trees, ecosystem points, and disturbance points.

1. Section and quarter section corners: The section and quarter section corners represent the framework of the land survey and the most signigicant component of the database. For the purposes of data entry, each possible section and quarter section corner in a given township has a number between 1 and 126 (Figure 5). This pattern of corners repeats itself in virtually every township of the state. Therefore, any corner in the state may be uniquely identified by its township, range, and corner number. There is a record in our database for each section corner and quarter section corner, and all witness tree data (species, diameter, azimuth, and distance) are included in these records. In the absence of witness trees, the codes in the database indicate if a mound or boulder was used instead, if a post was set but no trees were recorded, if the corner falls in a body of water, or if the corner falls in an Indian reservation or preexisting private claim. Figure 6 shows the species identified as the first bearing tree. The dominant timber and understory species found on a given mile are listed with one corner per mile; in general, the northern section corners on north-south section lines (e.g., corner 2 for the line between sections 35 and 36) contain the timber and understory species for those lines, and the quarter section corners in the middle of east-west section lines (e.g., corner 6 for the line between sections 24 and 25) contain the timber and understory species for those lines. For the township lines bordering the south side of townships, the western section corners on east-west lines (e.g., corner 13 for the line along the south side of section 35) contain the timber and understory species for those lines. Appendix B2 contains lists of all the species codes used in the database.
2. Meander corners: the database contains records for all meander corners where posts were set and witness trees identified. Occasionally, a meander corner was established without reference to witness trees; in these cases, there are no corresponding records in the

database. Meander corner records contain the type of feature causing the meander (lake, river, claim, reservation, etc), the distance along the survey line where the feature occurs, and the bearing tree data (species, diameter, azimuth, and distance).

3. Line trees: there is a record in the database for each line tree noted, including its type, diameter, and distance along the survey line. This data type is also used to record the location of cultural features encountered on the survey lines such as roads, trails, fences, houses, cabins, and mills.
4. Ecosystem points: much of Wisconsin was forested at the time of the survey, but there were many other types of ecosystems present on the land and recorded in the notebooks. The database contains records at the occurrence of most but not all of these. Each record includes the type of ecosystem encountered, the distance along the survey line it occurred, and whether it was entered or left at that point. Appendix B1contains the ecosystems codes used in the database.
5. Disturbance points: the notebooks contain evidence of natural and anthropogenic disturbance events, such as windfall, fire, and agriculture. These records contain information about the type of disturbance entered or left as well as the type of ecosystem that was disturbed.

Each record contains the township, range, and section corner numbers. In the case of section and quarter section corners, this corresponds to the geographic location of the corner. In the case of the other data types, this corresponds to the corner from which the feature was measured. For example, the record for a line tree encountered 1000 links north of a given corner will contain the township, range, and corner number of that corner. The exact geographic location of the line tree can then be calculated by adding 1000 links (660 feet) to the x-coordinate of the corner from which it was measured.

All data points also contain a code indicating the type of ecosystem in which the feature occurs (see Appendix B1). For example, a section corner set in an oak opening in southwestern Wisconsin will have an ecosystem code of O. This is in addition to separate

ecosystem points in the database that identify where the surveyor recorded entering and leaving that opening. Similarly, if a data point occurs in a disturbed area, the type of disturbance is reflected in the Disturb field. This is in addition to separate disturbance points that identify when the surveyor recorded entering and leaving the disturbance.

Additionally, each record in the database contains a field called Notes. This field contains any further narrative information that does not fit into the structure of the database, but may be of interest to database users. For example, the surveyor may have specified that the dominant timber species on the eastern half of the mile are maple, birch and aspen while those on the western have are linden and elm with scattering white pine.

There are several types of features that appear in the notebooks but were not captured in the database:

1. bodies of water too small to require meandering around, such as streams, brooks, runs, small ponds, etc.
2. ecosystem points at the entrance or leaving of wet areas (swamps, marshes, and valley bottoms). See Caveats to the database Part II, below for more information.
3. topographic features, such as ridges and ravines
4. the descriptions of land surface and soils recorded at the end of each mile surveyed.

Error assessment

Upon completion of data entry, 5% of all interior surveys and 5% of all exterior surveys were randomly chosen to quantify error rates. The contents of the database for these townships were printed out and compared to the original field notes, and errors introduced during data entry were tabuled by database field (see Appendix C). Error rates for all fields except Ecosystem were less than 2%, and the error rate for Ecosystem field was less than 3%.

The databases

The data resides in 2 separate tabular databases, corresponding to the data types outlined above: Corners; and Linetrees, Meanders, Ecosystems, and Disturbances. Appendix A explains the contents of all fields, many of which are shared among databases, with more detailed descriptions. Appendix B contains lists of the codes that appear in some fields and their definitions. These data can be used in tabular form for statistical analysis, or they can be brought into a geographic information system (GIS) for mapping, comparison to other spatial datasets, and spatial analysis (see Data and Database Use below).

Caveats to the database Part I: The General Land Office Survey

There are numerous issues regarding this database that must be taken into account when using the data. Some of the issues are rooted in the original survey and how it was conducted, and other issues grew from the manner in which we constructed the database.

With respect to the General Land Office survey of Wisconsin, there is a great deal of variability seen in the field notes due to the long time period required to complete the survey and the number of individuals who worked on it. It took 34 years to complete the majority of the survey, as all but five townships were surveyed between 1832 and 1866 (Figure 7). The basic framework of the survey did not change over time, but the General Land Office issued new sets of instructions to be given to the deputy surveyors in 1833, 1846, 1851, and 1855. Prior to 1855, general instructions were published as circulars and included with all contracts. Special instructions pertaining specifically to that contract may have been included as well. The instructions of 1855 were published as a more formal handbook, The Manual of United States Surveying, thus standardizing the surveys in all parts of the country. The Manual was then updated and republished periodically, although most of these updates occurred after the completion of the survey of Wisconsin. Changes in the procedures affected the number of witness trees identified at a given section corner, the regularity with which line trees were noted, whether or not the surveyors subdividing townships into sections set posts when they reached township boundaries, and other aspects. A review of surveyors' instructions and how the changes affected the survey in Wisconsin can be found in Onsrud (1979).

Over 100 surveyors worked in Wisconsin over this time period (Figure 8). There are many differences in the way individual surveyors conducted their surveys, beyond differences induced by changes in instructions. Many of these differences are obvious from looking at the data. Some surveyors consistently used genus names to identify certain trees (e.g., birch, pine) while most identified trees by species (e.g., yellow birch, red pine). Overall, 79% of birches, 16% of pines, 27% of maples, and less than 1% of oaks were identified in the notes only to the genus level.

The common names used to identify trees varied widely. What is called red pine today (*Pinus resinosa*) may have been called red, Norway, yellow, or sugar pine in the field notes. It appears that some common names migrated west with the surveyors and were applied to species in Wisconsin that resembled those known in the east. For example, pitch pines are noted throughout the survey although *Pinus rigida* is not found in Wisconsin. This common name was probably being applied to *Pinus banksiana* (jack pine), which ranges from New England to Minnesota. Some common names that appear in the notebooks are simply vague (e.g., yellow wilson, palm willow, blair). It is possible that these represent extremely obscure common names or typographic errors introduced during the transcription process, and overall they are very rare in the database.

Another obvious difference among surveyors is the volume of information they recorded. Some surveyors very regularly included one or two line trees between each section and quarter section corner and described in great detail the different ecosystems through which they passed. Some listed six, eight, even ten dominant timber species along a single mile. Others included no line trees, made no mention of changes in ecosystem, and listed one or two dominant timber species, if any. It is possible that these differences are due to real differences seen in the field or to the instructions the surveyors received, but it is equally probable that each surveyor had his own approach to surveying and his own interpretation of the instructions. For example, A. Millard subdivided Township 42 North, Range 9 East in 1861. He noted in addition to the 85 interior section and quarter section corners that are found in every township 20 meander corners and 102 line trees. Four years later J. McBride surveyed the township immediately to the west. He noted

85 section and quarter section corners, 11 meander corners, and no line trees. Clearly these two surveyors had different opinions as to the importance of including line trees in their field notes.

There are also differences between surveyors that are not so apparent from casually looking at the data, but have been identified through statistical analysis. Numerous studies have found biases in the species, diameters, and compass quadrant of the trees chosen as witness trees as well as the distance the trees lay from the survey post (Bourdo, 1956; Delcourt and Delcourt, 1974). Manies (in press) reviewed many of these studies and found statistically significant bias in the species and diameters of witness tress in data contained in this database for northern Wisconsin. Surveyors in her study area favored some species over others and appeared to prefer trees of certain size classes. These biases will certainly affect analysis of forest composition and structure

Although we extracted presettlement vegetation information from the field notes in order to compile this database, the original survey was not conducted as a biological or botanical inventory. It was primarily a land survey, and the biological content of the notebooks was collected and included in the notebooks to support the survey and otherwise secondary. It is crucial to remember when using this vegetation data that it was collected by surveyors rather than botanists, and done so neither systematically, consistently, nor objectively.

Caveats to the database Part II: The database itself

Our goal was to capture as much of the vegetative and ecologically relevant information as possible from the notebooks, rather than to create a complete transcription of the field notes. To this end, we ignored certain elements of the survey records that were of little use or interest to us (see the list above in the general database description). There is however one significant natural feature that might be of interest to users of this database that was not captured. We did not create ecosystem point data records when the surveyors mentioned entering or leaving wetlands, such as swamps, marshes, and river bottoms, because there were simply too many of them in northern Wisconsin. Any feature that occurs in these areas does have an ecosystem

code that correctly reflects type of wetland in which the feature sits, but the actual location where the surveyor entered or left that wetland is not included in the database.

There exists in the notebooks a certain amount of ambiguity, confusion, and vagueness regarding ecosystems. For much of the state, there is no explicit mention of the type of ecosystem in which the surveyor was travelling. Ecosystem type may be surmised from the nature of the corners: those with trees nearby were likely to be in forests and those marked by mounds or boulders and lacking witness tree information were probably in prairie or very open savanna. Currently we use an ecosystem code of F, default or unmentioned, for these points. A user wishing to accurately map ecosystems based on the ecosystem codes assigned to each point may need to develop a methodology for defining ecosystem type more precisely when the code is F, based on other data included with these records.

In some cases, an ecosystem was explicitly entered but never left, or vice versa. Examination of adjacent section lines may explain where the other boundary of the ecosystem was, but if not, the ecosystem was assumed to end at the next section corner, after which the ecosystem code reverted to F. In other cases, a surveyor entered one ecosystem and then entered another without explicitly stating that he left the first. For example, the surveyor may have entered a barren at 2500 links and heavy timber at 4200. In a case such as this, the database will contain records for entering both ecosystems as well as a record for the implied leaving of the first ecosystem upon entering the second.

The description of the line reported at the end of the mile may include an indication of the ecosystem when there is no record of entering or leaving ecosystems along the survey line. For example, a section line may have been described as "land all swamp" or "oak openings." In these cases, all features found on that line will be coded as S (swamp) or O (oak openings). On other lines, the surveyor may have noted that he entered and/or left an ecosystem, and then at the end of the mile mentioned another ecosystem. For example, he may have entered a prairie at 6000 links and then described the mile as "scattering timber". In this case, any features occurring between 0 and 6000 links will have an ecosystem code 2 for scattered timber, and all other

features occurring between 6000 links and the end of the mile will have an ecosystem code P for prairie.

Data and Database Use

Early surveyors' records have been used for many years to study pre-European settlement forests and landscapes of North America. The nature of the surveys was quite different between the eastern United States, where metes and bounds surveys commonly followed settlement and were very irregular, and the territories west of the original 13 colonies, where the U.S. General Land Office surveys were conducted prior to widespread settlement. In both areas, the vegetative information contained in the survey records has been of great assistance to ecologists trying to better understand the natural history of the continent and the effects of European settlement on the land (see Siccama, 1971; Russell, 1981; Foster et al., 1998 for work in the eastern states; Bourdo, 1956; Iverson, 1988; Galatowitsch, 1990; for work in the midwestern and western public lands states; Kline and Cottam, 1979; White and Mladenoff, 1994; Radeloff et al., 1998; He et al., 2000 for work in Wisconsin).

Currently the database exists in tabular form and lends itself to statistical analysis. In order to display the data on a map, perform spatial analysis on it, or combine it with other geographic data such as soils, geology, landtype associations, or current land cover within a GIS, we have developed a procedure to attach the data to a geographic coverage of the section and quarter section corners called Landnet produced by the Wisconsin Department of Natural Resources (WDNR, 1996). Landnet contains the point locations for all corners, each uniquely identified by a code called corn-id, which is an 11 digit concatenation of range direction, township, range, section, and corner. For example, the section corner in the southeast corner of Township 35 North Range 15 East, section 36, has a corn-id value of 43515360000. Given the numbering conventions of Landnet outlined in its technical documentation, the identical corn-id values can be calculated for each section corner record in the presettlement vegetation database, and the data can then be attached to the Landnet's attribute table using standard relational database techniques. The x- and y-coordinates of any feature that occurs between section and quarter

section corners (meander corners, line trees, and ecosystem points) can be calculated by starting with the coordinates of the corner from which the feature was measured and adding or subtracting the distance contained in the Links field of the database (converted first to Landnet's geographic units, most likely meters) from the x- or the y-coordinate, depending on the direction from the corner the surveyor was traveling when he encountered the feature. Radeloff et al. (1998), Radeloff et al (1999), and He et al (2000) show examples of how this presettlement data was brought into a GIS and spatially analyzed.

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APPENDIX A - FIELD DESCRIPTIONS

TOWNSHIP

- Number of townships north of Base Line.

RANGE

- Number of ranges east or west of 4th Principal Meridian.

RANGDIR

- Direction with respect to the 4th Principal Meridian:
  2 = west
  4 = east

POINTDIR

- Direction the surveyor was traveling when marking the point (not used for quarter or section corners):
  2 = south true
  3 = west true line
  4 = east true line
  6 = west corrected line
  7 = north (true or corrected)
  8 = east corrected line
  9 = south (true or corrected).

LINKS

- Distances always expressed as links (100 links = 1 chain).
- 1 mile = 80 chains; 1 chain = 66 feet; 1 link = 7.92 inches

PTYPE

- Point type
  P = section or quarter section corner
  M = meander corner
  L = line tree
  E = ecosystem point
  D = disturbance point

VEGTYPE

- Code representing the ecosystem in which the point is located (see Appendix B1).

DISTURB

- Code representing what type of disturbance a feature has experienced (see Appendix B1).

INOUT

- Code describing whether the surveyor entered or left the ecosystem or disturbance in question.
  1 = enter
  2 = left

MTYPE

- Code describing the reason for the meander:
  L = lake
  P = pond
  M = marsh
  B = bayou
  S = state line
  C = private claim
  I = Indian reservation
  D = road
  F = fractional section
  E = special circumstances

- The E code was used when surveyors recorded more than the normal quarter and section corners. This occurred most frequently when errors in the survey of the township lines required that some of the section lines were substantially longer than 1 mile, requiring the establishment of corners at the 1.5

mile point. In some townships within Indian reservations, extra corners were set on each section line to allow for the protraction of the section into 1/8 and 1/16 sections.

SP1-4
- Code representing the genus or species of the witness or line tree (see Appendix B2). Some codes also represent other objects noted in the survey, such as mounds, boulders, roads, trails, homes, etc.
- When the surveyor explicitly recorded “no trees” we used the code NO and when the surveyor didn’t write anything at all, we used the code NL.

DIAM1-4
- Diameters of trees as listed in the notes, in inches.
- If the surveyor listed a fraction for the diameter (i.e. 8 1/2), which rarely happened, the fraction was dropped when number was entered into the Diam field.

AZ1-4
- The compass bearing of the witness tree from the corner.
- The values consist of 3 parts: a north or south bearing, a number of degrees between 1 and 89, and an east or west bearing. For example: N19E, or S44W.
- Fractions of degrees or seconds (i.e., N19½E or S44º30'W) were dropped from the bearing as it was entered into the database.

DIST1-4
- The distance of the tree from the corner, in links.

FSP
- A list of the dominant timber species listed at the end of each section line, using the same genus and species codes as the SP1-4 fields (see Appendix B2).
- One word descriptions recorded with the timber species were sometimes included with the list (i.e, scattered oaks = SCAT OA; pine barrens = PI BARREN). Longer descriptions (i.e., pine on south 1/2 sugar & hemlock on north 1/2) are inlcuded in the Notes field.

USP
- A list of the dominant understory species listed at the end of each section line, using the same genus and species codes as the SP1-4 fields (see Appendix B2).
- This information was quite commonly not included in the field notes, for which the code NL was used.
- The surveyor did not always clearly distinguish which species were considered timber and which understory. When this distinction was vague, all species were listed as FSP unless they were clearly undergrowth, such as prickly ash, hazel, vines, grass, etc.

SURVEYOR
- The first initial, middle initial (if present), and last name of the surveyor or surveyors.

YEAR
- Year the survey was performed. If two years are listed (year contracted and year completed) the year the survey was completed was used.

NOTES
- Narrative information of interest recorded by the surveyor.

CORN-ID
- Wisconsin Department of Natural Resources corner identification number. See '24K Landnet Spatial Database Technical Documentation', 1996, for more information.

X-COORD, Y-COORD
- X and Y coordinates of feature, in the Wisconsin Transverse Mercator projection based on the 1991 adjustment to the North American Datum of 1983 (WTM83/91). For section and quarter section corners, these coordinates are extracted directly from the WI DNR's Landnet database. For all features, the X and Y coordinates were calculated from the point direction and the links from the coordinates of the corner from which the surveyor was traveling.

APPENDIX B1 - ECOSYSTEM AND DISTURBANCE CODES

Code	Ecosystem
A	Creek
B	Oak Barren
E	Meadow/not-man-made field
F	Default (unmentioned)
G	Grove
H	Bottom
I	Pine opening/barren
J	Pine grove
K	Scattered oak
L	Lake, pond
M	Marsh, wetland
N	Dry land
O	Oak opening
P	Prairie
Q	Barren (undifferentiated)
R	River, slough
S	Swamp
T	Thicket, brush
X	Forest/timber
Z	Wet prairie
2	Scattered timber
3	Opening (undifferentiated)
4	Dead forest
5	Sparse timber / little timber
7	low land, low wet area
8	Thinly timbered
9	Unknown

Code	Disturbance
2	Digging
3	Fire
4	Windfall
5	Man-made field
6	Sugar camp
7	Town, village
8	Farm
9	Slashing, old pinery, clearing

APPENDIX B2 - GENUS AND SPECIES CODES

Code	Species
AL	Alder, aldar
AN	Annis
AU	Annual plants
AP	Apple
AR	Arrow bush
AD	Arrow wood
AM	Artifical mounds
AH	Ash
AS	Aspen, Popple, Poplar
EB	B. Berry
LE	B. elm
LF	B. Leaf
BG	Balm of gilead, Balsam poplar
FI	Balsam, Balsam fir, Fir
BP	Bap
RY	Barberry
BN	Barn
BZ	Bars
LI	Basswood, Bass, Linden, Linn, Lynn, Lind
AZ	Bastard hazle
TP	Bastard pine
BE	Beech
BY	Berry
BI	Birch
SU	Bird's Eye maple, Hrd maple, Rock maple, Sugar, Sugar maple
IT	Bitternut
BQ	Bittersweet brier
BC	Black (undifferentiated)
LL	Black alder
BA	Black ash, B ash, Brown ash
BB	Black birch, B birch, Blk birch
LK	Black briers
CH	Black cherry, B cherry, Blk cherry, Cherry
BH	Black hase, Black hause
LA	Black haw
LJ	Black jack
KL	Black locust
LM	Black maple
LO	Black oak, B oak, Blk oak
JP	Black pine, Jack pine, J pine, Jk pine, Pitch pine, P Pine
BS	Black spruce, B spruce, Blk spruce
LT	Black thorn
BW	Black walnut, B walnut, Blk walnut, Walnut
KW	Black willow
LB	Blackberry
LR	Blair
LD	Blow Down
UA	Blue ash
BL	Blue beech
UB	Blue birch
BF	Blue grass
BJ	Blue joint grass
GG	Bog grass
IB	Bois blanc
BD	Boulder, rock (large stone used as a witness tree)
BX	Boxelder
BK	Brakes
RR	Briars
BR	Brush, bushes, underbrush
KB	Buck brush

Code	Species
BV	Buffalo clover
UG	Buffalo grass
RX	Bull rushes
BO	Bur oak, Br oak, Burr oak
BM	Burial mound
BU	Butternut, B'nut, White walnut, W walnut
BT	Buttonwood
CA	Cabin
CG	Cane grass
CT	Catbriers
CS	Cattails
CE	Cedar
CM	Cemetary
CH	Cherry, Black cherry, B cherry, Blk cherry
CC	Choke Cherry
XB	Corner does not exist, ie irregular township
XA	Corner exists but is missing on film, ie pages missing from notebook
XC	Corner in a private claim or Indian reservation
CO	Cottonwood, Cotton
CR	Crab apple, Crab
CB	Cranberry
CU	Current
DA	Dam
DK	Deer lick
DI	Diggings
DS	Dock
DG	Dogwood
DL	Dry elm
YP	Dry pine
DF	Dwarf fir
DM	Dwarf maple
DO	Dwarf oak
DP	Dwarf pine
ED	Elder (undifferentiated)
EL	Elm (undifferentiated)
EV	Evergreens
FM	Farm
FN	Fence
FE	Ferns
FR	Ferry
FD	Field
FI	Fir, Balsam, Balsam fir
FG	Flagg grass
FL	Flagstaff
FB	Flat blade grass
FO	Formation (bed or range of rocks)
FT	fort/fortification
FU	furnace
GA	Garden
GS	ginseng
GB	Gooseberry
GE	Grape
GR	Grass
GV	graveyard
GY	Gray ash
GP	Gray pine
RA	Green ash, Red ash
NB	Green briars
GX	Green bush
GO	Green osier
GZ	Ground hazel
GH	Ground hemlock

Code	Species
GI	Ground pine
GU	Grubs
HA	Hackberry, H'berry
HH	Hard hack
SU	Hard maple, Rock maple, Sugar, Sugar maple, Bird's Eye maple
HK	Hard oak
HP	Hard pine
HD	Hardwood
HF	Haw
HW	Hawthorn
HY	Hay
HZ	Hazelnut, Hazel
HE	Hemlock
HR	Herbs
HL	Hickory elm
HI	Hickory, Hick, H'ory, Hkry
HM	Home, House
HS	Hops
HO	Hornbeam
HU	Huckleberry
HC	Hunters camp
XX	Illegible, indeterminable
IW	Indigo weed, Indigo plant
IR	Ironwood, Iron, I'wood
IV	Ivy vines
JO	Jack oak, J oak Jk oak, Yellow oak, Pin oak, Spanish oak
JP	Jack pine, J pine, Jk pine, Black pine, Pitch pine, P Pine
JU	Juniper, Red cedar
KI	Kinnikinick
TA	Larch
DR	Lead running
LW	Leatherwood
LI	Linden, Linn, Lynn, Lind, Basswood, Bass
LN	Line
OC	Locust
LG	Lodge
LC	Lumbering camp
LY	Lynch
MA	Maple
MG	Marsh grass
MH	Marsh hay
ME	Masonic weed
YC	May cherry
ML	Mill
MB	Moose brush
MW	Moosewood
MR	Morel grass
MO	Moss
MD	Mound
MT	Mountain ash
MI	Mountain willow
MP	Muskrat swamps
NE	Nettles
NJ	New Jersey tea
NO	No tree around or similar quotation in place of species listing
NL	None listed—no trees are listed in notes
RP	Norway pine, N pine, Yellow pine, Y pine, Sugar pine, Red pine, R pine
OA	Oak (undifferentiated)
OB	Oak Bushes
OO	Osier (undifferentiated)
OV	Overcup
AW	Palm willow

Code	Species
WB	Paper birch, White birch, W birch, Wht birch
PV	Pea vines
JO	Pin oak, Yellow oak, Jack oak, J oak Jk oak, Spanish oak
PI	Pine (undifferentiated)
PD	Pinewood
JP	Pitch pine, P Pine, Black pine, Jack pine, J pine, Jk pine
PL	Plum
PR	Poison elder
OI	Poison ivy
PC	Poison sumac
AS	Popple, Poplar, Aspen
PT	Post (a post is used as a witness tree)
PO	Potato patch
AC	Prairie Cane
CK	Prairie dock
PG	Prairie grass
PW	Prairie willow
PE	Prickles
PA	Prickley ash
PP	Princess pine
RL	Railroad
RS	Raspberries
RQ	Rattlesnake weed
RA	Red ash, Green ash
JU	Red cedar, Juniper
RC	Red cherry
RE	Red elm
RH	Red haw
DZ	Red hazle
RI	Red indigo
RM	Red maple, R maple
RO	Red oak, R oak
RP	Red pine, R pine, Norway pine, N pine, Yellow pine, Y pine, Sugar pine
RT	Red root
RG	Red top grass
RW	Red willow
RB	Reeds
RV	River maple
RD	Road (used only in association with the line tree option)
RK	Rock elm
SU	Rock maple, Hrd maple, Sugar, Sugar maple, Bird’s Eye maple
BD	Rock or boulder
RZ	Rose
OW	Rose willow, roze willow
RN	Rosin weed
RU	Rushes
SL	S Maple
PN	S Pine
AG	Saplings
SX	Sassafrass
UO	Scrub oak, Shrub oak
SC	Scrub pine
SB	Serviceberry
AO	Shamrock
LH	Shilbark hickory
MK	Shoe make
SN	Shop
SJ	Shrubs
UM	Shumach
KO	Sinkhole
ES	Slippery elm
FC	Smelting furnace

Code	Species
SM	Soft maple
JO	Spanish oak, Yellow oak, Jack oak, J oak Jk oak, Pin oak
SI	Spice
SK	Spikenard
MS	Spotted maple
SG	Spring of pure water
SP	Spruce (undifferentiated)
PS	Spruce pine (one case of spruce fir)
QP	Squaw pine
SV	Squaw vine
SD	Station
SY	Strawberry
ST	Street
UC	Sugar camp
SS	Sugar house
RP	Sugar pine, Norway pine, N pine, Yellow pine, Y pine, Red pine, R pine
SR	Sugar tree
SU	Sugar, Sugar maple, Hrd maple, Rock maple, Bird's Eye maple
MC	Sumac
SA	Swamp ash
PH	Swamp beech
PB	Swamp birch
PK	Swamp burr oak
SQ	Swamp elder
SE	Swamp elm
XG	Swamp grass
SH	Swamp hazel
PM	Swamp maple
SO	Swamp oak, S oak
SZ	Swamp pine
SW	Swamp white oak
CI	Sweet cisily
WN	Sweet fern
YS	Sycamore
TA	Tamarack, Tam'k, Tamarac,Larch
TV	Tavern
TK	Thicket
TS	Thistle
TH	Thorn
TN	Thorn apple
TT	Thorn tree
RR	Thornbriars, Briars
TB	Thornbush
DE	Timber all dead or similar notation in place of species listing
TR	Trail (used only in association with the line tree option)
TU	Turpentine weed
VL	Village, Town
VI	Vines, Hop vines
BW	Walnut, Black walnut, B walnut, Blk walnut
QQ	Water
AA	Water ash
WU	Water beech, Water beach
WY	Water birch
AB	Water bush
AE	Water elm
TO	Water oak
WV	Water willow
WD	Weeds
WA	White ash
WB	White birch, W birch, Wht birch, Paper birch
WC	White cedar
WE	White elm, W elm

Code	Species
WF	White fir
HV	White haw (was WH-now HV eff 2-23-1999)
WK	White hickory
WM	White maple, W maple, Wht maple
OG	White oak grubs
WO	White oak, W oak, Wht oak
WP	White pine, W pine Wht pine
WJ	White poplar
WS	White spruce, W spruce, Wht spruce
WT	White thorn, W thorn
BU	White walnut, W walnut, Butternut, B'nut
WW	Whitewood
WH	Whortleberry
DC	Wild cherry
WL	Wild current
PY	Wild pears
PX	Wild peas
WR	Wild rice
YR	Wild rye
IG	Wild sage
XT	Wild tea
WI	Willow
WG	Wintergreen
IS	Wire grass
WZ	Witchhazel
WQ	Woodbine
YB	Yellow birch, Y birch
JO	Yellow oak, Jack oak, J oak Jk oak, Pin oak, Spanish oak
RP	Yellow pine, Y pine, Norway pine, N pine, Sugar pine, Red pine, R pine
YW	Yellow willow
YN	Yellow wilson

APPENDIX C - ERROR ASSESSMENT

	Interior surveys			Exterior surveys			Total		
Field	Values checked	Errors found	Error Percent	Values checked	Errors found	Error Percent	Values checked	Errors found	Error Percent
Point	12230	12	0.1	3251	0	0.0	15481	12	0.1
Pointdir	5492	27	0.5	1336	0	0.0	6828	27	0.4
Links	5228	110	2.0	1336	6	0.4	6564	116	1.8
Ecosystem	12230	350	2.9	3254	81	2.5	15484	431	2.8
Disturbed	217	0	0.0	51	0	0.0	268	0	0.0
InOut	788	2	0.3	207	0	0.0	995	2	0.2
Mtype	572	0	0.0	135	0	0.0	707	0	0.0
Sp1- 4	18458	61	0.3	6237	19	0.3	24695	80	0.3
Diam1 - 4	18457	64	0.3	6237	17	0.3	24694	81	0.3
Az1 - 4	13395	166	1.2	4657	42	0.9	18052	208	1.2
Dist1 - 4	13395	143	1.1	4657	34	0.7	18052	177	1.0
FSp	14630	206	1.4	3343	30	0.9	17973	236	1.3
Usp	6270	74	1.2	1293	8	0.6	7563	82	1.1

Figure 1

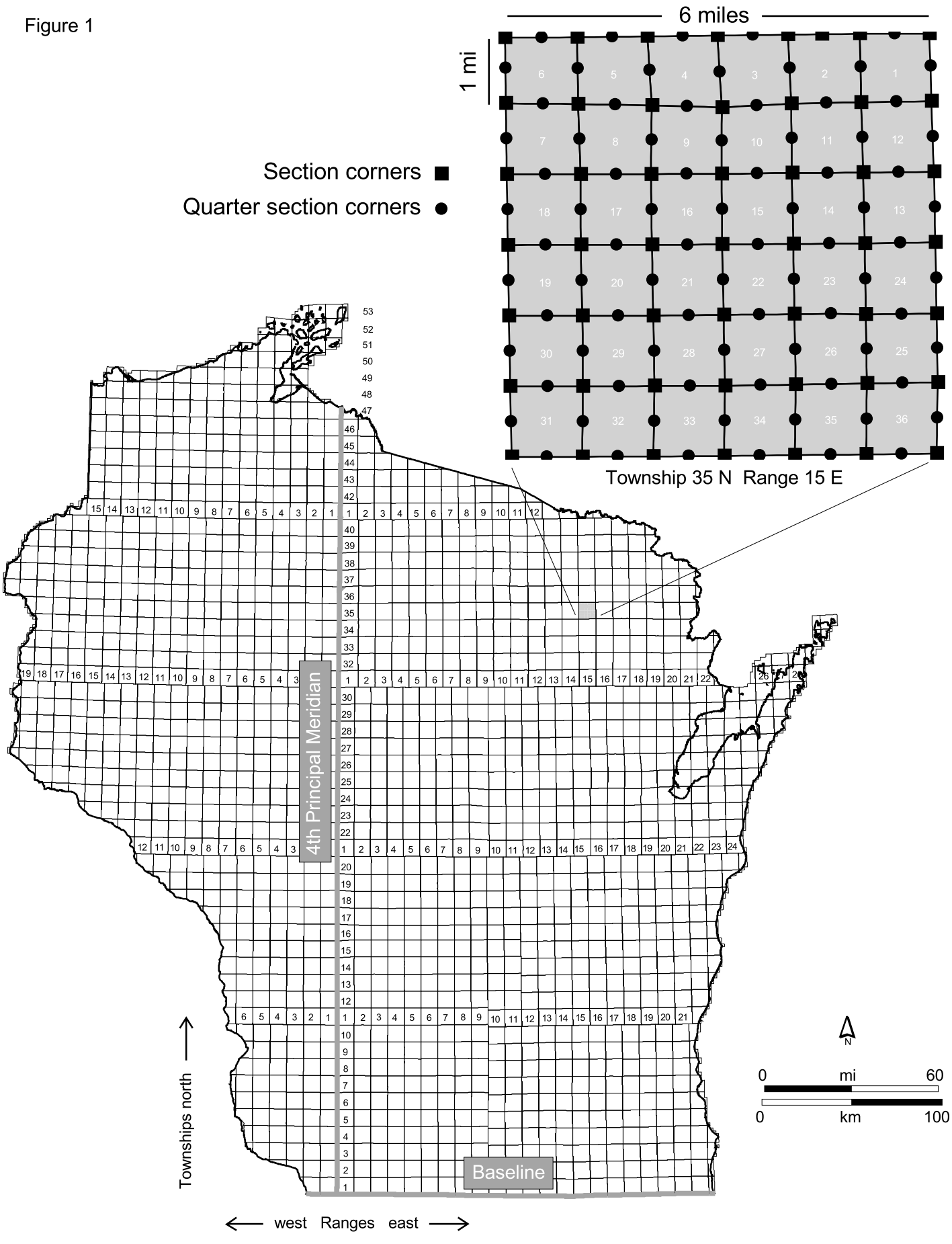
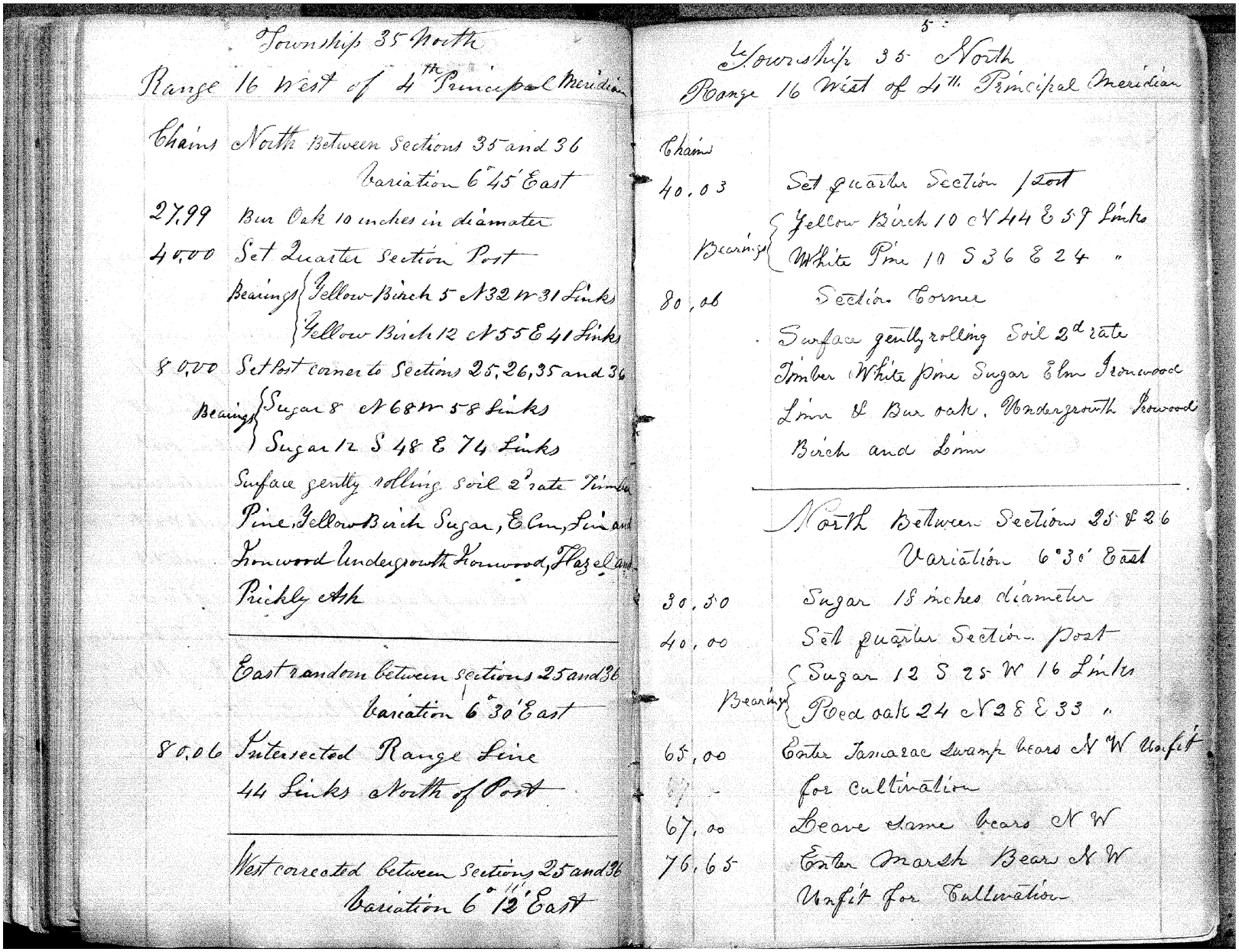

6 miles
1 mi
Section corners
Quarter section corners
Township 35 N Range 15 E
4th Principal Meridian
Baseline
Townships north
west Ranges east
N
0 mi 60
0 km 100

Figure 2



Township 35 North
Range 16 West of 4th Principal Meridian

Chains

North Between Sections 35 and 36
Variation 6° 45' East

27.99 Bur Oak 10 inches in diameter

40.00 Set Quarter Section Post
Bearings { Yellow Birch 5 N 32 W 31 Links
Yellow Birch 12 N 55 E 41 Links

80.00 Set Post corner to Sections 25, 26, 35 and 36
Bearings { Sugar 8 N 68 W 58 Links
Sugar 12 S 48 E 74 Links
Surface gently rolling Soil 2d rate Timber Pine, Yellow Birch Sugar, Elm, Lin and Ironwood Undergrowth Ironwood, Hazel and Prickly Ash

---

East random between sections 25 and 36
Variation 6° 30' East

80.06 Intersected Range Line
44 Links North of Post

West corrected between Sections 25 and 36
Variation 6° 12' East

5

Township 35 North
Range 16 West of 4th Principal Meridian

Chains

40.03 Set quarter Section Post
Bearings { Yellow Birch 10 N 44 E 59 Links
White Pine 10 S 36 E 24 "

80.06 Section Corner
Surface gently rolling Soil 2d rate
Timber White pine Sugar Elm Ironwood Linn & Bur oak. Undergrowth Ironwood Birch and Linn

---

North Between Sections 25 & 26
Variation 6° 30' East

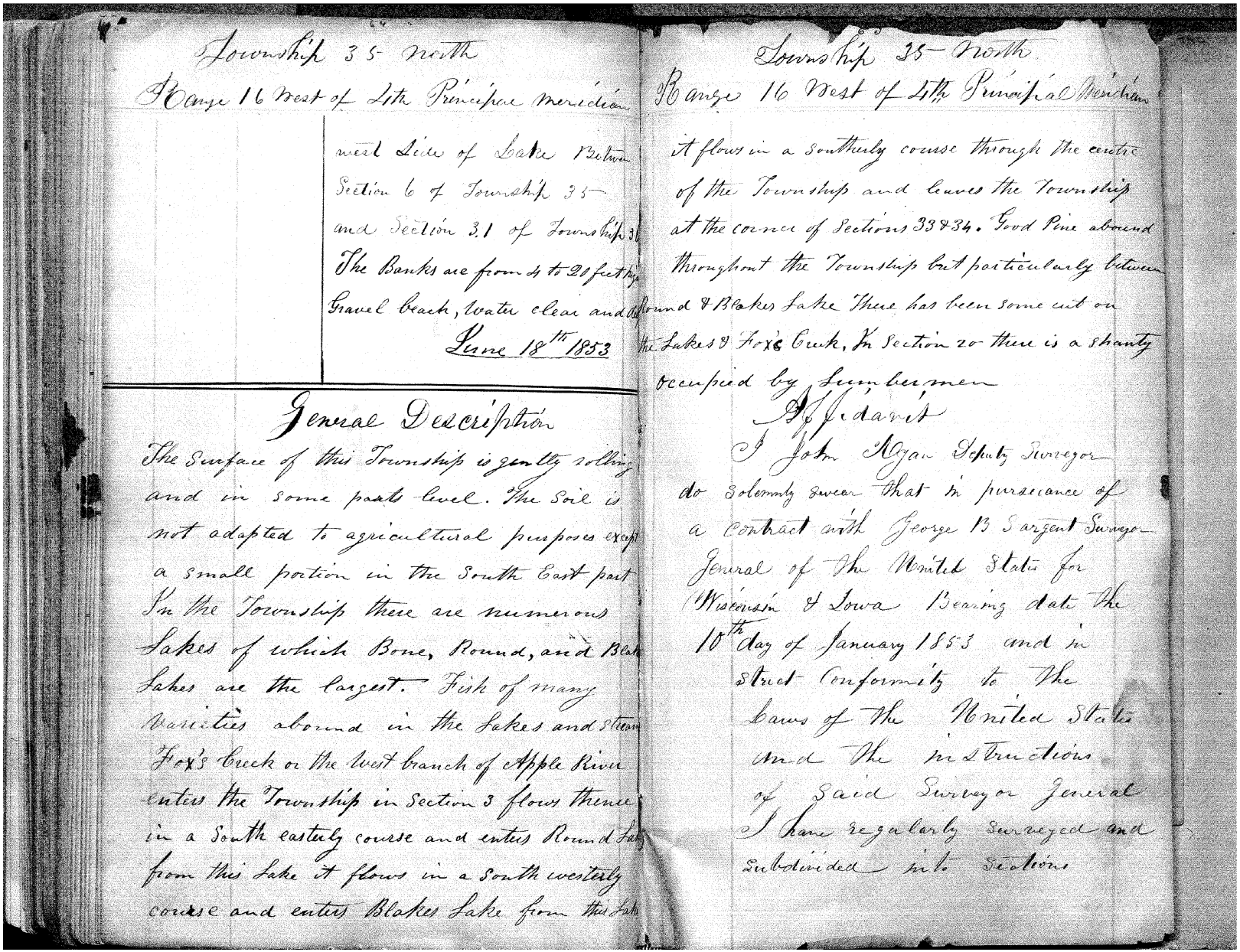
30.50 Sugar 18 inches diameter

40.00 Set quarter Section Post
Bearings { Sugar 12 S 25 W 16 Links
Red oak 24 N 28 E 33 "

65.00 Enter Tamarac Swamp bears N W Unfit for Cultivation

67.00 Leave same bears N W

76.65 Enter Marsh Bear N W Unfit for Cultivation



Township 35 North
Range 16 West of 4th Principal Meridian

west Side of Lake 13 between
Section 6 of Township 35
and Section 31 of Township 36
The Banks are from 4 to 20 feet high
Gravel beach, water clear and
Lease 18th 1853

General Description

The Surface of this Township is gently rolling
and in some parts level. The Soil is
not adapted to agricultural purposes except
a small portion in the South East part
In the Township there are numerous
Lakes of which Bone, Round, and Blak
Lakes are the largest. Fish of many
Varieties abound in the Lakes and stream
Fox's Creek or the West branch of Apple River
enters the Township in Section 3 flows thence
in a South easterly course and enters Round Lake
from this Lake it flows in a South westerly
course and enters Blakes Lake from this Lake

Township 35 North
Range 16 West of 4th Principal Meridian

It flows in a southerly course through the centre
of the Township and leaves the Township
at the corner of Sections 33 & 34. Good Pine abound
throughout the Township but particularly between
Round & Blakes Lake There has been some cut on
the Lakes & Fox's Creek, In Section 20 there is a shanty
occupied by Lumbermen

I John Regan Deputy Surveyor
do Solemnly Swear that in pursuance of
a Contract with George W Sargent Surveyor
General of the United States for
Wisconsin & Iowa Bearing date the
10th day of January 1853 and in
strict Conformity to the
Laws of the United States
and the instructions
of said Surveyor General
I have regularly Surveyed and
Subdivided into Sections

Figure 3

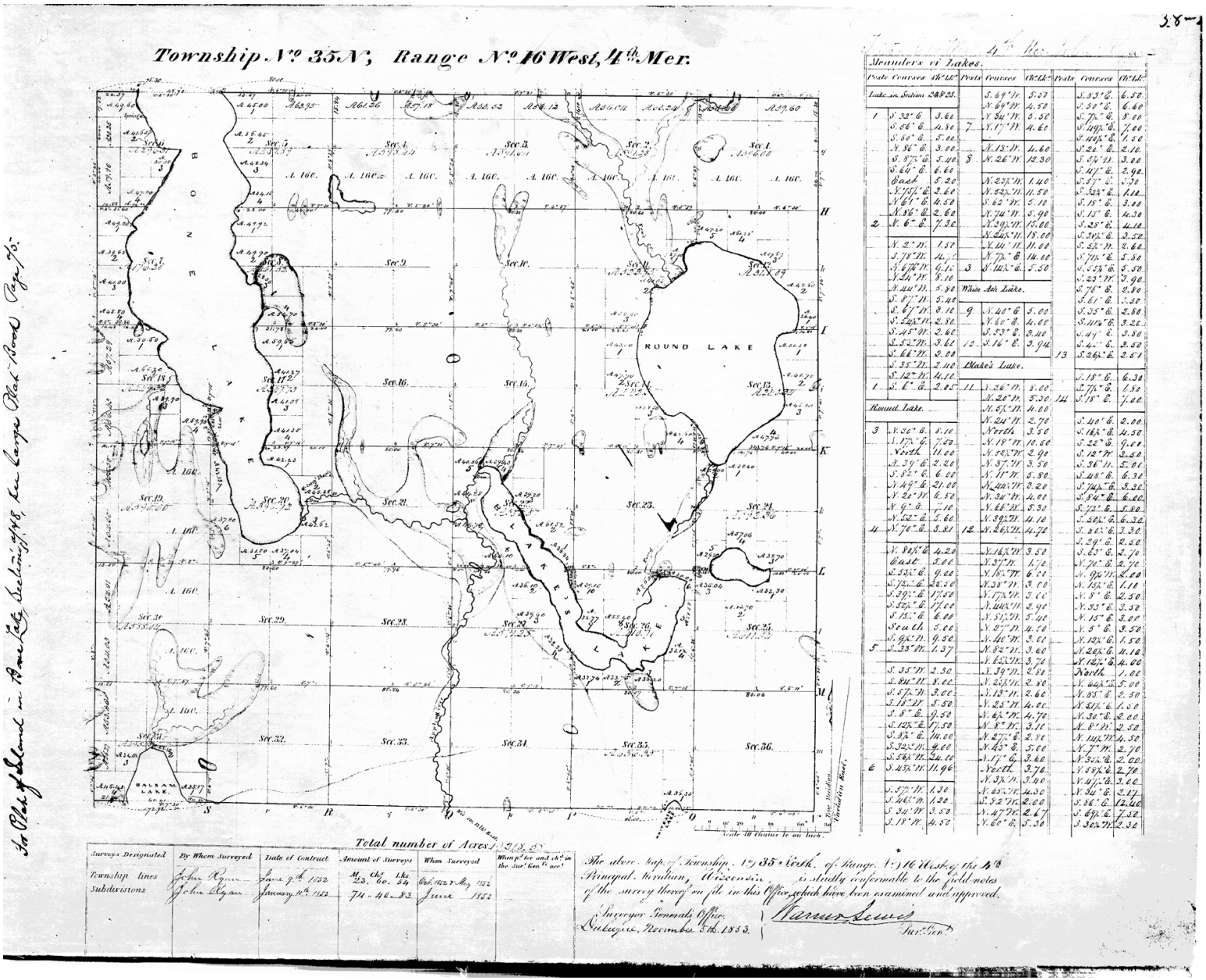

Township No. 35 N; Range No. 16 West, 4th Mer.
ROUND LAKE
BLACK LAKES
BONITO LAKE
BALSAM LAKE
Meanders of Lakes.
Total number of Acres
Surveys Designated
By Whom Surveyed
Date of Contract
Amount of Surveys
When Surveyed
Township lines
Subdivisions
John Ryan
John Ryan
The above Map of Township No. 35 North of Range No. 16 West of the Gila & Salt River Meridian, Arizona is strictly conformable to the Field-notes of the survey thereof on file in this Office which have been examined and approved.
Surveyor Generals Office
Dubuque, November 5th 1853.
Surv. Gen.

Figure 4

Figure 5

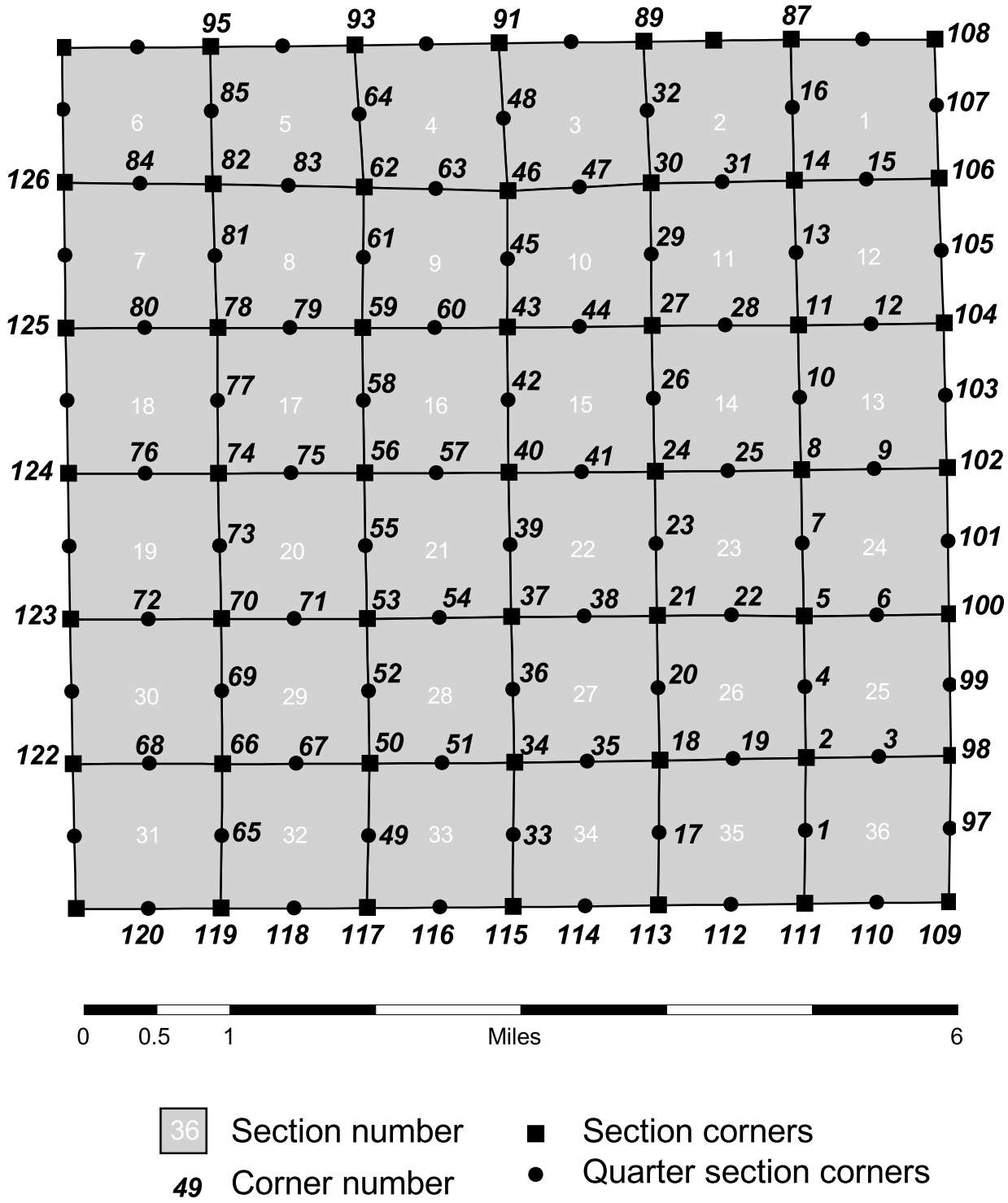

95 93 91 89 87 108
85 64 48 32 16 107
6 5 4 3 2 1
84 82 83 62 63 46 47 30 31 14 15 106
126
81 61 45 29 13 105
7 8 9 10 11 12
80 78 79 59 60 43 44 27 28 11 12 104
125
77 58 42 26 10 103
18 17 16 15 14 13
76 74 75 56 57 40 41 24 25 8 9 102
124
73 55 39 23 7 101
19 20 21 22 23 24
72 70 71 53 54 37 38 21 22 5 6 100
123
69 52 36 20 4 99
30 29 28 27 26 25
68 66 67 50 51 34 35 18 19 2 3 98
122
65 49 33 17 1 97
31 32 33 34 35 36
120 119 118 117 116 115 114 113 112 111 110 109
0 0.5 1 Miles 6
36 Section number
49 Corner number
Section corners
Quarter section corners

Figure 6

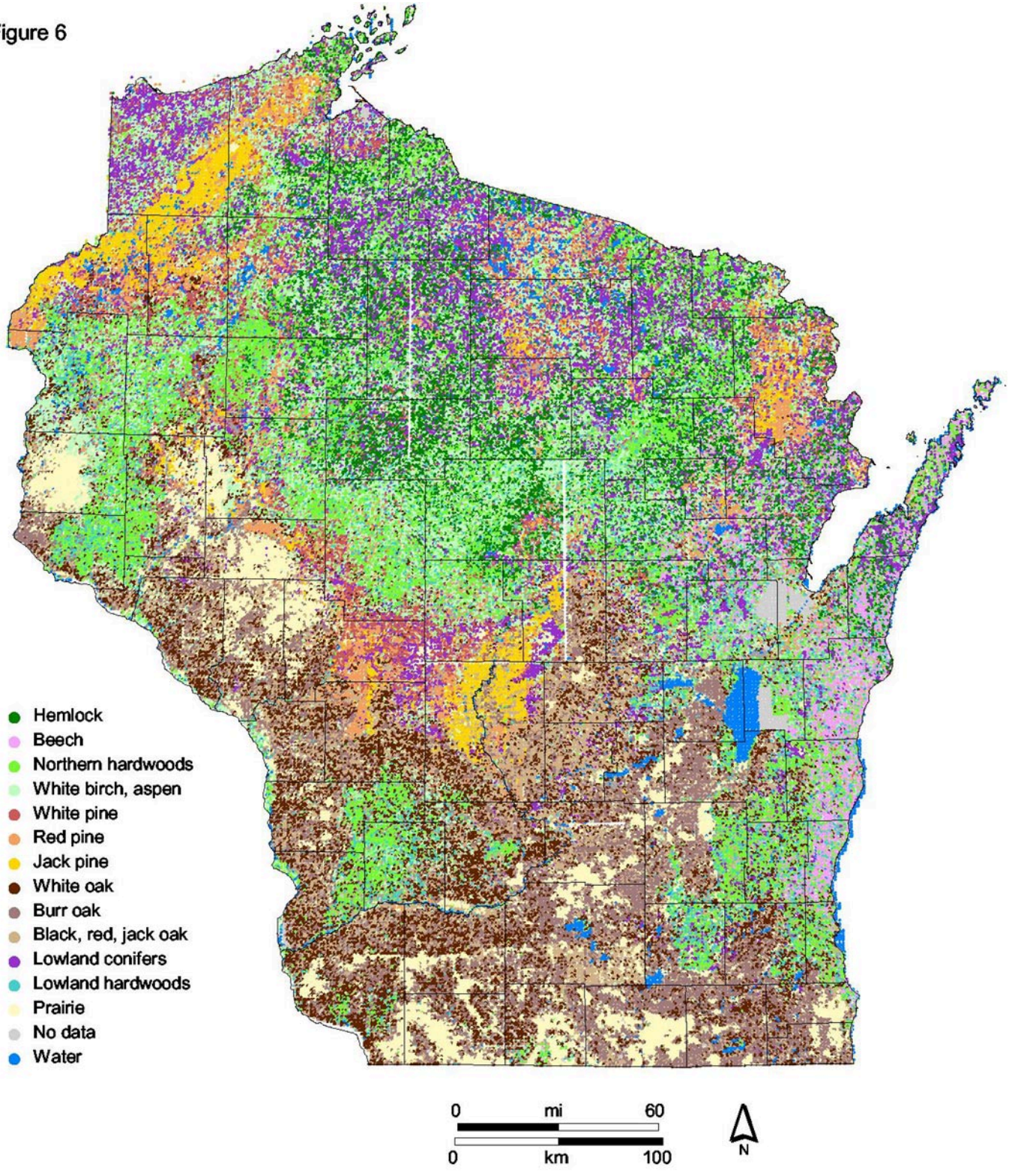

Hemlock
Beech
Northern hardwoods
White birch, aspen
White pine
Red pine
Jack pine
White oak
Burr oak
Black, red, jack oak
Lowland conifers
Lowland hardwoods
Prairie
No data
Water
0
mi
60
0
km
100
N

Figure 7

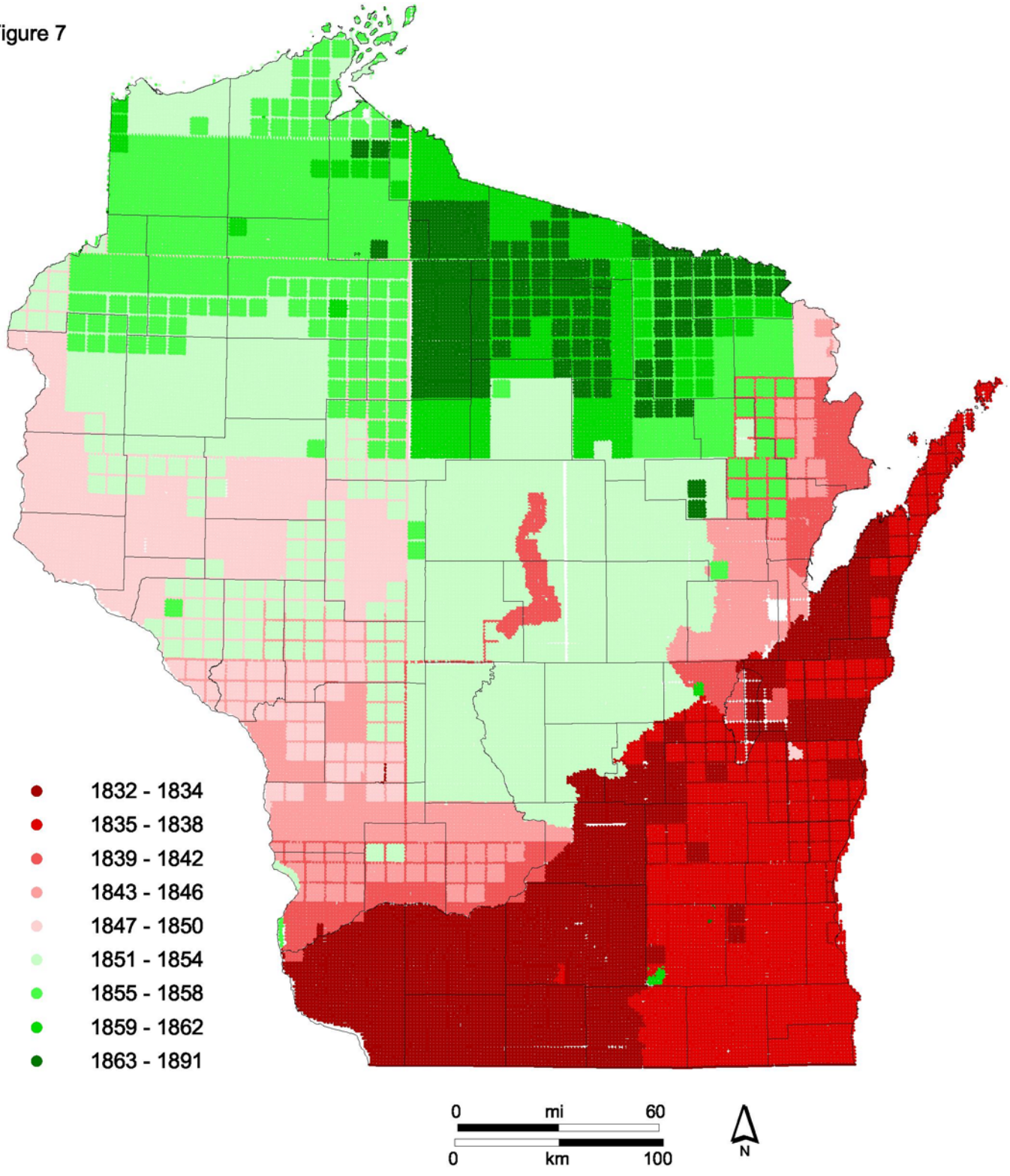
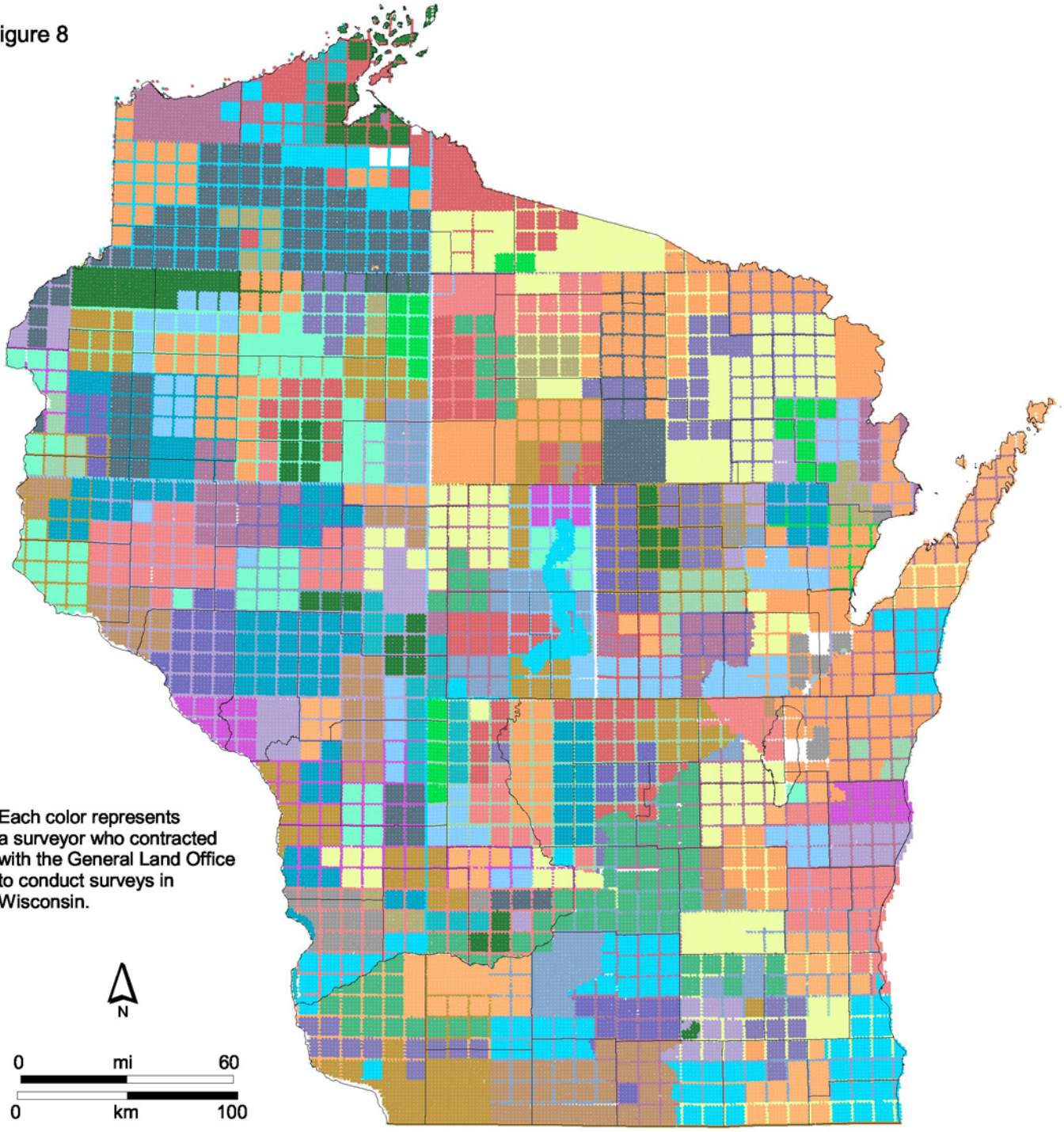

1832 - 1834
1835 - 1838
1839 - 1842
1843 - 1846
1847 - 1850
1851 - 1854
1855 - 1858
1859 - 1862
1863 - 1891
0
mi
60
0
km
100
N

Figure 8


Each color represents
a surveyor who contracted
with the General Land Office
to conduct surveys in
Wisconsin.
N
0
mi
60
0
km
100